COMPUTER CONTROLLED SYSTEM FOR MODULARIZING THE INFORMATION TECHNOLOGY STRUCTURE OF A BUSINESS ENTERPRISE INTO A STRUCTURE OF HOLONIC SELF-CONTAINED MODULES

Technical Field

5   The present invention relates to the information technology structure of business enterprises including business organizations of such expansive scope that their functions and business processes are interrelated through the Internet or World Wide Web (Web) or like networks.
10   The invention particularly relates to systems for reorganizing the information technology of such business enterprises to achieve the fullest advantages of opportunities offered by the Web.

Background of Related Art

15   The past decade has been marked by a technological revolution driven by the convergence of the data processing industry with the consumer electronics industry. The effect has, in turn, driven technologies which have been known and available but relatively
20   quiescent over the years. A major one of these technologies is the Internet or Web (the terms are used interchangeably herein) related distribution of documents, programs, media and all other data processing entities. The convergence of the electronic
25   entertainment and consumer industries with data processing exponentially accelerated the demand for wide ranging communication distribution channels and the Web or Internet, which had quietly existed for over a generation as a loose academic and government data
30   distribution facility, reached "critical mass" and commenced a period of phenomenal expansion.

As a result of this expansion, extraordinary worldwide communication channels and resources have become available to businesses on a relatively inexpensive basis. This has commenced an era which will

5 forever change how business processes are conducted. Business organizations including business enterprises (the term is used here to define organizations of such scope that many divisions and separate but interrelated companies are involved) are becoming increasingly modular

10 in nature, i.e. with many shared processes and functions. This is, of course, greatly facilitated by the distribution and tracking functions provided by the Web.

Business entities must out source various functions or activities to other enterprise divisions, companies,

15 partners and even contractor or subcontractor organizations. As a result of Internet functions and capabilities, these out source participants may be in different cities or countries.

However, this out sourcing or like collaboration

20 between different organizations and companies requires the sharing of resources, such as business processes and databases. Each out sourcing company often has to make available to one or more of the others, databases, application programs and other resources that the others

25 may need to complete their activity. This gives rise to the obvious need for up to literally hundreds of points of contact between business entities, dependent upon the size of the business enterprise or organization.

In addition, with the development of the Web,

30 virtually all organizations have been driven to perform a substantial portion of their sales, marketing and customer distribution functions over the Web. These activities coupled with the above-described

organizational functions have become known as e-Business, and their business organizations known as e-Business enterprises.   To deliver value to their customers, companies of all sizes use partners: suppliers,

5   complementary providers, distributors and shippers correlated through the Web.

Many companies and even large enterprises have responded to all of the above changes in the market place environment and needs on a piecemeal basis by adding

10   resources and function as needed within each of their individual business entities or functions without any overall organization-wide overall plan.   The business organizations wrestling with the complexities of plugging such individual resources and functions into the business

15   organization or enterprise as needed are seeking information technology-centric protocols to solve many of these problems.

Summary of the Present Invention

The present invention provides a system for

20   facilitating the reorganization of the information technology of a business organization into a structure that is modular and, thus, interchangeable between business units within the enterprise, and particularly within Web enterprises involving several correlated

25   companies.

The invention involves a computer controlled system for modularizing the information technology structure of a business organization into a structure of interchangeable holonic self-contained modules, with each

30   module performing a set of related functions.   The system comprises means for providing a plurality of sets of self-controlling holons, with each holon in each set

performing a business capability of the same type as performed by the other holons in its respective set, but each set of holons performing a different business capability type than the other sets of holons. There are

5 also means for providing a plurality of integration holons, with each integration holon respectively integrating the holons in one of the sets to provide a coordinated overall business capability of one of the different types. The system also provides for

10 modularizing the information technology structure of a business organization so that an integration holon integrates the holons in one of the sets to unitary overall combination business capability holons. Such combined sets of holons may perform a Web business

15 capability, an internal business organization capability and/or a data processing organization type of capability.

The holons are modular and may be interchanged to perform their respective capabilities in other information technology structures within the business

20 enterprise. In this respect, the organization structure may involve a holon directory listing of available interchangeable holons and the respective business capability of each of said available holons and means for registering an interchangeable holon in said directory.

25 The system may also include means for visualizing the modularized information technology structure of the business organization on a display of said computer controlled system.

Brief Description of the Drawings

30 The present invention will be better understood and its numerous objects and advantages will become more apparent to those skilled in the art by reference to the

following drawings, in conjunction with the accompanying specification, in which:

Fig. 1 is a generalized diagrammatic view of a network such as a local business organization network
5   connected through a server computer connected to other business organizations, units or partners through the Web, of which a portion is shown, on which the present invention may be implemented;

Fig. 2 is a block diagram of a data processing
10   system including a central processing unit and network connections via a communications adapter that is capable of functioning as any of the local business unit computers or the Web or other servers in the network of Fig. 1;

15   Fig. 3 is a diagrammatic sketch of a holon;

Fig. 4 is a diagrammatic sketch showing the relationship of a set of specialization (business capability) holons integrated through an aggregation (integration) holon;

20   Fig. 5 is a more particularized diagrammatic sketch illustrating the relationship between sets of business capability holons and their respective integration holons in the modular information technology structure of a business organization;

25   Fig. 6 is a more detailed diagrammatic view of some of the business capability and integration holons of Fig. 5;

Fig. 7 is an illustrative flowchart describing the setting up of the elements of the system of present
30   invention for modularizing the information technology of a business enterprise through the generation of sets of business capability holons respectively integrated through integration holons.

Detailed Description of the Preferred Embodiment

Before going further into the details of specific embodiments, it will be helpful to understand from a more general perspective the various elements and methods that

5   may be related to the present invention. First, since a major aspect of the present invention is directed to Web distribution and transactions, an understanding of such networks and their operating principles would be helpful. We will not go into great detail in describing the

10   networks to which the present invention is applicable. The present invention is applicable to a global network such as the Internet or Web. For details on Internet nodes, objects and links, reference is made to the text, Mastering the Internet, G. H. Cady et al., published by

15   Sybex Inc., Alameda, CA, 1996. The Internet or Web is a global network of a heterogeneous mix of computer technologies and operating systems. Objects are linked to other objects in the hierarchy through a variety of network server computers. These network servers are the

20   key to network distribution, such as the distribution of Web documents or pages that is used to describe data transmitted over the Web and is intended to include Web pages with displayable text, graphics and programs.

The present invention may be implemented using

25   object oriented programming systems and languages such as C++, COM, OLE or Java. Thus, it should be helpful to generally review the known principles of object oriented programming.

It should be understood by those skilled in the art

30   that object oriented programming techniques involve the definition, creation, use and instruction of "objects". These objects are software entities comprising data elements or attributes and methods, which manipulate the

data elements. The data and related methods are treated
by the software as an entity and can be created, used and
deleted as such. The data and functions enable objects
to model their real world equivalent entity in terms of
5   its attributes, which can be presented by the data
elements, and its behavior, which can be represented by
its methods.

    Referring now to Fig. 1, there is shown a very
generalized diagram of a Web portion on which the present
10   invention may be illustrated. In the examples which
follow, we will use the Web as the computer controlled
object oriented programming network system used by the
business enterprise, the information technology of which
is being organized and modularized in accordance with the
15   present invention. A localized business unit is
represented by a network 58 made up of a server 45 with
appropriate I/O 54 and several local business I/O
terminals, each consisting of a display 56 computer 57.
These computer I/O terminal 56, 57 may represent the data
20   processing system of a business entity in the unit, e.g.
any business function such as marketing, distribution,
manufacturing or financial; or the facility of a vendor,
contractor or like business partner making a functional
contribution to the business unit in the business
25   enterprise. Server 45 is typically connected to the Web
50 via standard Web wired connections through Web server
53 that may be provided by a commercial service provider
via connections 61. Reference may be made to the text,
Mastering the Internet, G. H. Cady et al., published by
30   Sybex Inc., Alameda, CA, 1996, particularly pp. 136-147,
for typical connections between local display stations to
the Web 50 via access server 53 through connection 51.

Other business units in the business enterprise may be
connected through the Web 50 to business unit network 58.
In this illustration, the other business units connected
via the Web are shown as Web business partners 60 and 62,

5 but these business units may also be in companies related
to that of the business units or divisions of the same
company.

Referring to Fig. 2, a typical data processing unit
is shown that may function as the computer display

10 terminals 57 or function as the network server computer
45 (Fig. 1). A central processing unit (CPU) 10, such as
one of the PC microprocessors or workstations, e.g.
eServer pSeries available from International Business
Machines Corporation (IBM) or Dell PC microprocessors, is

15 provided and interconnected to various other components
by system bus 12. An operating system 41 runs on CPU 10,
provides control and is used to coordinate the function
of the various components of the computer of Fig. 2.
Operating system 41 may be one of the commercially

20 available operating systems such as IBM's AIX or
Microsoft's WindowsMe™ or Windows 2000™, as well as UNIX
and other IBM AIX operating systems. Application
programs 40, controlled by the system, are moved into and
out of the main memory Random Access Memory (RAM) 14.

25 These programs include the programs of the present
invention in appropriate computers, the functions of
which are being modularized in accordance with the
present invention. These functions will be described
hereinafter. A Read Only Memory (ROM) 16 is connected to

30 CPU 10 via bus 12 and includes the Basic Input/Output
System (BIOS) that controls the basic computer functions.
RAM 14, I/O adapter 18 and communications adapter 34 are
also interconnected to system bus 12. I/O adapter 18

communicates with the disk storage device 20.
Communications adapter 34 interconnects bus 12 with an
outside network, i.e. the Web. I/O devices are also
connected to system bus 12 via user interface adapter 22

5   and display adapter 36. Keyboard 24 and mouse 26 are all
interconnected to bus 12 through user interface adapter
22. It is through such input devices that the user at
the client computers may interactively relate to the Web
programs of the present invention. Display adapter 36

10 includes a frame buffer 39, which is a storage device
that holds a representation of each pixel on the display
screen 38. Images may be stored in frame buffer 39 for
display on monitor 38. By using the aforementioned I/O
devices, a user is capable of inputting information to

15 the system through the keyboard 24 or mouse 26 and
receiving output information from the system via display
38.

    The present invention involves modularizing the
information technology structures of business

20 organizations through a combination of interchangeable
self-contained holonic modules. For the purpose of
functionally orienting the more detailed description of
the organization of the information technology into
holons that will follow, a self-contained holon is

25 diagrammatically shown in Fig. 3. Holons have been used
for years in Holonic Manufacturing Systems. Holons like
data processing agents are self-contained self-governing
units of an organization like a business unit that are
goal oriented. Thus, in the business organization,

30 holons are constructed to be units of operations that are
capable of evolving themselves in accordance with their
goals. Holons use three general functions that are
internal to the holon 65. They operate 67 to fulfill the

goals of the holon; they are self governing 66 to the extent that they sense, interpret and decide on whether to change; and responsive to such decisions, they are capable of adapting 68 to change the holon in response to

5   internal or external stimuli. In organizing and responding to information technology, the processing may be automated. Holons interact with each other using human-to-machine, or machine-to-machine interfaces.

In the organization of information technology of

10   business organizations, the holons function as sets of holons of the same business capability type with each set being integrated and controlled by an integration holon. The holons are structured using, for example, the Universal Description, Discovery and Integration (UDDI)

15   system developed and made publicly available through the World Wide Web Consortium (W3C). UDDI developed by a business standards consortium, including IBM, Microsoft and Hewlett-Packard Companies among others, provides a standard platform independent open framework through

20   which the holons created in the practice of the present invention may be integratable into and across business enterprises and units that ascribe to the framework standards for integration established by UDDI. Thus, by using the UDDI protocols, as will be hereinafter

25   described in greater detail, the holonic module combinations of this invention are interchangeable building blocks through which business enterprises may internally or externally organize their business operations. Details of current UDDI protocols are

30   available at the UDDI Web site, as well as through the W3C Web site.

Holons are interchangeable blocks. The design of holonic systems must be open, modular and standardized.

That is why the above-mentioned UDDI architecture,
standardized through W3C, is applicable to the holonic
organization of the present invention. Control of
holonic systems depends on communication, automation,
5   self-diagnosis and self-repair. Holonic architecture is
usually hierarchical with individual holons performing
subordinate and/or supervisory roles. depending on their
place in the hierarchy. Each holon is an autonomous
block which must cooperate with other blocks to achieve
10   the overall objective. Each holon has its own objectives
that sometimes conflict with the objectives of other
related holons. There must be negotiation of such
conflicts. The effectiveness of the negotiation will
have a significant effect on the efficiency of the
15   system. The standardization is primarily interface
standardization whereby the interchangeable holons must
interface so as to be integrated within the respective
frameworks.

In light of this background with respect to holonic
20   systems, the holonic system of the present invention will
now be considered in greater detail. With reference to
Fig. 4, there is illustrated a unit in the holonic system
used to modularize the information technology structure
of a business organization. Specialization holons 70-74,
25   each perform a specialized business capability of the
same type, usually within one operating unit of the
business; aggregation holon 69 could be referred to as an
integration holon in that it functions to coordinate or
integrate the business capabilities of specialization
30   holons 70-74 across different operating units. It should
be noted that aggregation holon 69 is represented as a
cluster of holons. The reason for the cluster is that
any of the specialization holons 70-74 may be joined to a

number of aggregation holons. As set forth above,
holonic architecture is usually hierarchical with
individual holons performing subordinate and or
supervisory roles depending on their place in the
5   hierarchy. Each holon is an autonomous block that must
cooperate with other blocks to achieve the overall
objective. Thus, aggregation holon 69 in the present set
up is a combination holon of subordinate holons that
performs the above-mentioned coordination function.

10   With reference to Fig. 5, the organization format
described with respect to Fig. 4 will be applied to the
holonic modularization of the information technology of
an illustrative business unit. The overall Internet or
Web applicable holonic structure will be referred as the
15   Value-Net that is an architecture defining the overall
Web capability holonic functions. The holonic structure
is made up of three sets of business capabilities:
Value-Net Capabilities 79, Business Capabilities 81 and
IT Services Capabilities 83; as well as four integrating
20   or coordinating functions: Value-Net Manager 78,
Business Capabilities Manager 80, IT Services Manager 82
and Network Infrastructure Manager 84. All seven of
these functions will be carried out by holons: the set
of Business Capabilities 81 are carried out by a set of
25   corresponding specialization holons 76; the set of IT
Services Capabilities 83 are carried out by a set of
corresponding specialization holons 77; and the set of
Value-Net Capabilities 79 are carried out by a set of
corresponding specialization holons that are not shown.
30   Similarly, the Value-Net Manager 78 coordination function
is carried out by aggregation holon 75. The Business
Capabilities Manager 80, IT Services Manager 82 and
Network Infrastructure Manager 84 functions are

respectively carried out by aggregation holons that are
not shown.

In the illustrative business unit of Fig. 5, Value-
Net Manager Holon 75 representative of manager function
5   78 acts to establish and manage relationships between
parties in the network arrangement, as well as setting
and monitoring network goals and behaviors.
Specialization holons, not shown, representative of net
capabilities 79 act to execute capabilities in support of
10 the network functions. A manager or coordination holon,
not shown, representative of Business Capabilities
Manager function 80 will provide a framework that
coordinates the Business Capabilities 81 to enable
generation, operation and tracking of interconnections
15 between the business capabilities. Business Capabilities
81 are, in turn, represented by business capability
specialization holons 76 that create specific business
value or process value creation. A manager or
coordination holon, not shown, representative of IT
20 Services Manager function 82 will provide a framework
that offers the information technology platform
supporting the interaction of humans and machines to
enable the IT Services 83. Such IT services are, in
turn, represented by and provided by IT services
25 specialization holons 77. Another manager or
coordination holon, not shown, represents Network
Infrastructure Manager to provide a framework supporting
the telecommunications network backbone access to link
the network participants and resources.
30   Now, with reference to Fig. 6, there will be an
elaboration of Fig. 5 in order to detail the functioning
of three of the holons of Fig. 5: the organization of a
business capabilities holon 76; the organization of

another specialization holon, IT services holon 77, as
well as a coordination holon 85, not previously shown,
for the IT Services Manager function. In the details of
business capabilities specialization holon 76 in Fig. 6,
5   there is detailed the internal holon operate 86, govern
87 and adapt 88 functions that were previously just
outlined in the illustrative holon of Fig. 3 to show the
subordinate functions that must be coordinated to perform
the overall holonic functions. Likewise, the details of
10   IT services holon 77 shows the subordinate functions that
must be coordinated into order to achieve the operate 89,
govern 63 and adapt 64 functions. Also, an IT services
coordinating holon 85 is detailed in order to illustrate
the subordinate functions that must be combined to carry
15   out the coordination function.

It has been previously mentioned that the
organization structure may involve a holon directory
listing available interchangeable holons and the
respective business capability of each of said available
20   holons and means for registering an interchangeable holon
in said directory. For holons conforming to the UDDI
standard interface protocols, as described above, the
UDDI maintains a UDDI Business Registry which may be
accessed on the Web at www.uddi.

25   In addition, the holonic structure of the business
organization may be set up so that the components in the
various holons may be displayed in the form shown in Fig.
6 on the displays of the various participating computer
display terminals described in Figs. 1 and 2.

30   Fig. 7 is a flowchart showing the development of a
process according to the present invention for the
modularization of the information technology structure of
a business organization into a structure of holonic self-

contained modules. Through a computer controlled display system, there is provided access to all databases storing the data processing technology of the business organization or business unit under study, step 90. An

5   object oriented programming system is provided through data processing holons may be generated, step 91. In the study of a business organization, provides for the division of the organization into business units, step 92. Enable the organization of the functions of the

10   business units into self-contained holons with each holon performing a distinct Business Capability, step 93. Enable the organization of the holons into sets of holons with each holon in a set performing a Business Capability of the same type, step 94. Enable the organization of

15   several sets of holons with each set of holons being of a different type than the holons in the other sets, step 95. For each set of holons, provide for the generation of an integration holon to coordinate the holons in the set to provide a coordinated overall Business Capability

20   of one of the different types, step 96. Provide for the generation of sets of holons of Web services business capability type, step 97. Provide for the generation of sets of holons of internal business organization capability type, step 98. Provide for the generation of

25   sets of holons of data processing business organization capability type, step 99.

One of the preferred implementations of the present invention is in application program 40. Until required by the computer system, the program instructions may be

30   stored in another readable medium, e.g. in disk drive 20, or in a removable memory, such as an optical disk for use in a CD ROM computer input or in a floppy disk for use in a floppy disk drive computer input. Further, the program

instructions may be stored in the memory of another computer prior to use in the system of the present invention and transmitted over a Local Area Network (LAN) or a Wide Area Network (WAN), such as the Web itself,

5 when required by the user of the present invention. One skilled in the art should appreciate that the processes controlling the present invention are capable of being distributed in the form of computer readable media of a variety of forms.

10 Although certain preferred embodiments have been shown and described, it will be understood that many changes and modifications may be made therein without departing from the scope and intent of the appended claims.